



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**

**REGION 2**

**2890 WOODBRIDGE AVENUE**

**EDISON, NJ 08837**

# Niagara Falls Boulevard Site Disposal Procedures

**Submitted by:**

USEPA ERT Health Physicist Lyndsey Nguyen

USEPA EPA Region 02 Eric M. Daly

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## **CHARACTERISTICS OF THE SITE**

### Property Description

The Niagara Falls Boulevard (NFB) Site is a mixed commercial and residential area of Niagara Falls, New York. The site consists of two parcels, namely 9524 and 9540 Niagara Falls Boulevard, and encompasses approximately 2.53 acres. Currently, the 9524 Niagara Falls Boulevard property contains a bowling alley, Rapids Bowling Alley, and an asphalt parking lot. The 9540 Niagara Falls Boulevard property contains a building supply center, Greater Niagara Building Center, and an asphalt/concrete parking lot. The properties are bordered to the north by a wooded area; to the east by a church; to the south by Niagara Falls Boulevard, beyond which is a residential area; and to the west by a hotel and residential area. The Site Location Map is attached in Attachment A.

### Waste / Site Contamination Areas

It is believed in the 1960s, slag—type material was used as fill for the properties' parking lot area. During the operations of filling the parking lot, slag was pushed onto edges of the parking lot and dumped in areas adjacent to the parking lot. The term "slag" has been used by many of the citizens of Niagara Falls as a means to describe processed ore in a porous rock formation, or a green or black glass-like opaque rock. From the historical site assessment, EPA believes that this slag originates from the extraction of niobium from ores that also contained source material nuclides (uranium and thorium) resulted in elevated concentrations of the naturally occurring radionuclides (U, Th, and Ra). As a result, this material is being managed as TENORM." Figure 1 shows the physical characteristics of the two types of slag underneath the asphalt parking lot. The Figure also shows the distinct layering found underneath majority of the Site's surface.

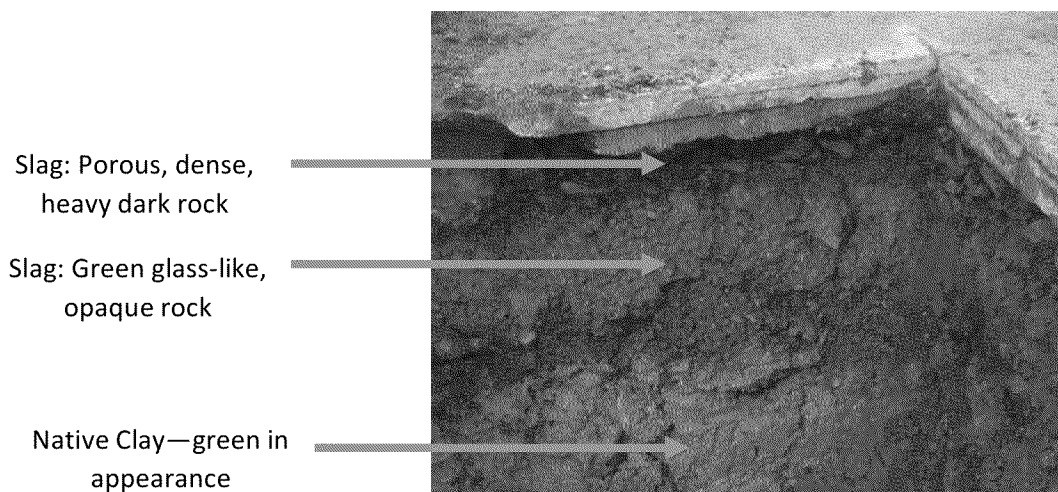


FIGURE 1. Picture of the various layers underneath the asphalt parking lot showing two type of slag.

### Disposal Purpose

The NFB Site has shown an external risk to the public and workers to Ra-226, Ra-228, and Th-232 concentrated in slag and/or soils mixed with other waste related to slag. To minimize the risk to the public and workers, EPA is conducting a removal action to remove all soil, surfaces, and/or debris such as wood, concrete, and asphalt, in areas that demonstrate contamination above EPA's cleanup action limits:

Radionuclide of Concern	Concentrations (pCi/g)*
Ra-226	2.48
Ra-228	15.9
Th-232	5.12

\*where "pCi/g" is a concentration of radioactivity that stands for picoCuries per gram

Based on the data from characterizing the site, the removal would include excavating all soils until native soil/clay is reached, approximately 24 inches below the surface. The native soil/clay from this area has shown both U-238 and Th-232 in equilibrium with concentrations of 1.5pCi/g or less (i.e. roughly 18 mg/kg [*i.e.* milligrams per kilograms] of total U+Th). Although it is not EPA's intention to dispose of clean soil, to be conservative, an additional 6 inches to 1 foot may be excavated after native soil/clay has been reached. This may be performed to ensure that cleanup action limits have been met.

### Area Descriptions

As described previously, the NFB site shows majority of contamination of slag within the first six inches below asphalt/concrete surface of the parking lot. This layering has also been observed in portions of on-site building structures that were built on top of the asphalt after slag placement. In areas along the asphalt areas, where slag may have been pushed off the edges when grading the parking lot, contamination of slag is found mainly at the surface. In rare cases, the slag maybe intermixed down to native clay (*i.e.* approximately 2 feet below surface) due to agitation of the soil. Although the slag can be

easily identified, even visually via layers and/or high gamma measurements, the concentrations vary throughout the site. To gain a better picture of the site, EPA has divided the site into seven “Areas” as seen in Attachment B where each Area can be described as following:

Area 1	Area 1 is the back of the parking lot. This area contains majority of the contamination. By sampling/scanning, the contamination appears to be in the first 6 inches below the asphalt. It is suspected that contamination may become deeper along the northern edge of Area 1 to account for uneven terrain.
Area 2	Area 2 is the parking lot in front of the bowling alley, as well as between the bowling alley and the building supply center. From sampling/scans, it is suspected that slag was only placed along the building supply center side of this parking lot.
Area 3	Area 3 is located on the west side of the building supply center. This area is used for loading/unloading of large trucks, as well as limited parking for customers. The area consists of asphalt and some sections of concrete. The majority of the contamination is low in this area—located mainly on the northern edge of the property near Area 1 and Area 7.
Area 4	Area 4 is located on the western most side of the building supply center. Very little contamination is suspected except for the northern location of Area 4; however, the scan data may be elevated due to the close proximity to Area 7
Area 5	Area 5 is on the east side of the parking lot. It is suspected that this section of the site has contamination due to leveling of the parking lot. The high contamination is located in a few piles of visible slag. Due to the land being agitated, some locations within Area 5 show slag at depths of 18 inches.
Area 6	Area 6 does have contamination but is limited to the southern border of this area, adjacent to Areas 1, 5 and 7. Area 6 has not been fully characterized and will be addressed in later phases.
Area 7	Area 7 is a fenced in area with exposed slag. There is a very thin layer of crumbled asphalt. Area 7 and Area 1 have roughly the same concentrations of contamination.

## OUR PROPOSED APPROACH

The general approach for the disposal of material at NFB is to take a conservative approach. EPA has outlined, in the following paragraphs, the specifics for each step taken to ensure that each disposal trailer load is less than the Waste Acceptance Criteria (WAC) established by US Ecology of total Uranium and Thorium less than 500 mg/kg and Ra-226 less than 50pCi/g. Although this is a general approach, specifics for each Area for disposal will be presented and approved by US Ecology’s Health Physicist throughout the disposal process. This will ensure that all qualitative measurements and quantitative data used to determine concentrations are representative of the Area(s) as well as calculated correctly per disposal truck load. Approval from US Ecology’s Health Physicist must be granted for any methodologies and/or procedures that veer from EPA’s general approach as described below. A flowchart outlining EPA approach is found in Attachment C.

## Scanning

The first task that EPA will performed is a scan of the entire site broken down by each predetermined Area as diagramed in Attachment B. The scan will be performed using a 3"x 3" sodium iodide (NaI) probe. The goal of the scan is to be able to determine intensity of radiation compared to background. Shine, due to sources of radiation nearby, geometry, physical characteristics (*i.e.* can slag be visibly seen at the surface) and radon, must be taken into consideration when reviewing the scan data to scientifically delineate the contamination within each designated Area. Each Areas' scanning locations will be GPS linked and a visual product will be created to determine sections of elevated radiation (*i.e.* high concentrations versus low concentrations). All scans will be compared to a reference background located in the un-impacted location as seen in Attachment B, labeled as "Background." Locations within each Area above a set value, such as three times background, will be considered "high" concentrations, and will be delineated by sampling for the purpose of determining the concentration for volume of the high concentration material located within each area. The same approach will be conducted for the low concentration material located in each area. Scanning with NaI is only to be used for qualitative data, such as identifying "hot spots"—localized sections of elevated gamma measurements, and delineating high concentrations of contamination both by surface area and depth. Scanning with NaI will not be used to quantify soil concentrations. Only soil samples analyzed by HpGe and/or alpha spectrometry will be used for quantifying soil sample concentrations.

## Sampling

Based on the scan data, sampling within each Area will be performed to building a relationship between the scan data to concentrations found in the soil samples (*i.e.* mg/kg). Sampling should include locations within each Area of varying intensities of radiation (e.g. a sample from background, twice background, three times background, four times background, etc.) to get a comprehensive understanding of the concentration of waste located within each Area. Qualitative scan data will serve as a general overview and will supplement, not replace, quantitative soil sample results. In addition, the sample locations, as well as the number of samples, within each area will also depend on the physical characteristics of the contamination, if slag is seen at the surface or specific layers.

The goal for sampling is to answer the following questions regarding each Area:

- Which areas are considered elevated?
- Are there sections of higher elevated portions (*i.e.* "high") versus lower elevated portions (*i.e.* "low") within an overall Area?
- Are there any "medium" concentrations (e.g. portions of a specific Area that falls between low and high concentration values)?
- Do the "high" elevated areas require blending? Blending at this Site does not mean literally mixing or homogenizing material but rather taking different units (cubic yard box, container or pile of material) of concentrations and staging them in the proper ratio as one disposal load.
- What is the total volume of high elevated material including surface area and depth?
- What is the total volume of low elevated material including surface area and depth?
- Is there enough low concentration material to blend the high concentration material within the designated Area?
- Do we need to blend using more than one Area to meet the WAC?

With multiple samples being collected to characterize the waste at each Area, the highest sample concentrations of total Th+U, in units of mg/kg, within the locations will be identified as “high level material” value. Similarly, the highest sample concentration of total Th+U, in units of mg/kg, within the remaining portion of that specific area (which is lower in concentration in comparison to the “high”) will be identified as “low level material” value. Averaging of the samples collected for all “high level” concentration values and averaging all of the samples for the “low level” concentration values will not be performed for the Area. Only the highest values will be used. This is to ensure a conservative/over-estimate for our blending calculation, if needed, and to ensure overall concentrations per shipment are below the WAC for US Ecology. Figure 2 shows an example of how the concentrations for high and low will be determined for one Area.

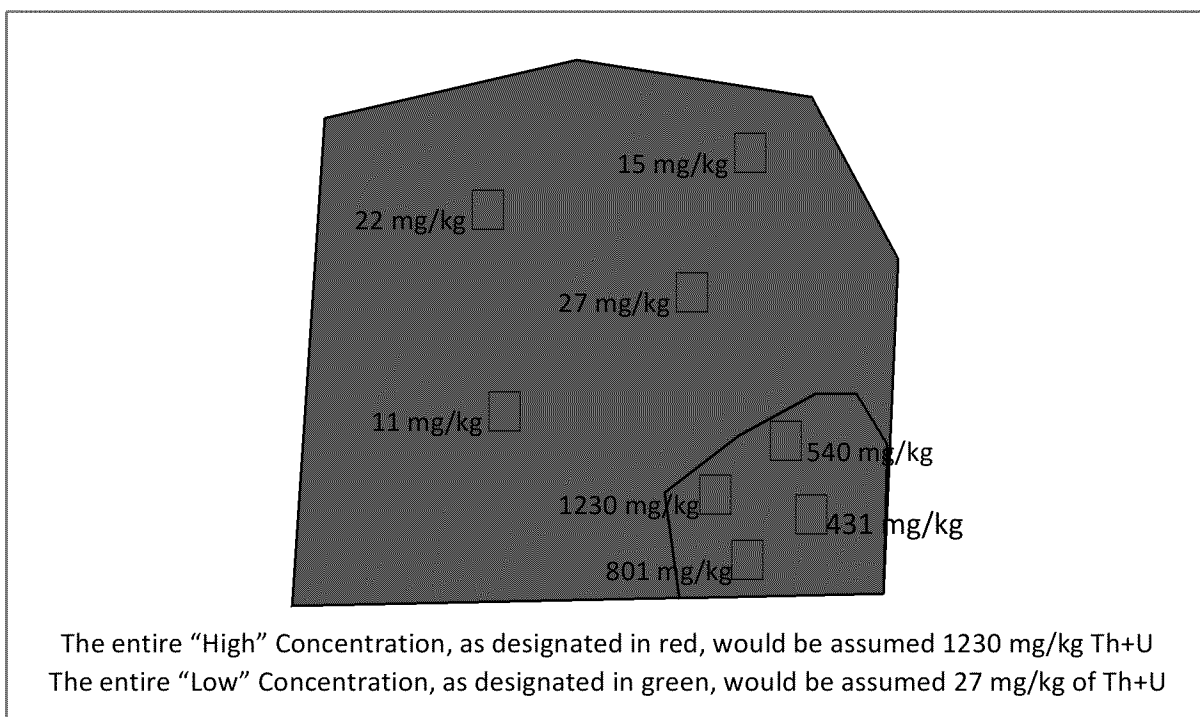


FIGURE 2. Example of setting the high concentration value and low concentration value for determining if blending is needed of this particular Area.

#### Technique for Analysis

All soil samples will be analyzed on the NFB on-site High purity Germanium (HpGe) detector. Due to the uniqueness of waste—having both thorium waste and extracted thorium waste—the HpGe counting procedure for the radionuclides of interest (*i.e.* thorium, uranium, and radium) will depend mostly on the decay products within each decay chain. When reviewing the historical data sent to a certified fixed laboratory, the results show elevated levels of radium in both decay chains with thorium and uranium much less than radium. For the U-238 decay chain, Th-234 can be used for determining U-238, U-234, and Th-230. However for the Th-232 decay chain, one specific progeny cannot be easily assigned to the parents. Assigning the concentration of the progeny to the parent would depend on the type of waste—is the waste in equilibrium or disequilibrium? For instance, using the daughter of Ac-228 for an estimation of Th-232 and Th-228 concentrations would be overly estimated for samples in disequilibrium. From previous data, the Ac-228 was seen as high as at twice the concentration of Th-

232. This would double the amount of Th-232 and would cause unnecessary additional need for blending. On the other hand, if samples are in equilibrium, for instance background samples, the concentration of Ac-228 could be accurately assigned to Th-232 and Th-228. To better clarify, Table 1 shows which progenies would be assigned to the parent based on equilibrium.

Parent Radionuclide	Daughter Radionuclides used Depending on Type of Sample	
	Samples in equilibrium	Samples out of equilibrium
Th-232	Ac-228	Th-228
Ra-228	Ac-228	Ac-228
Ac-228	Ac-228	Ac-228
Th-228	Ac-228	Ra-224
Ra-224	Ac-228	Pb-212
Pb-212	Ac-228	Bi-212
U-238	Th-234 (then Pa-234m then Ra-226)	
Th-234	Th-234 (then Pa-234m then Ra-226)	
Pa-234	Th-234 (then Pa-234m then Ra-226)	
Pa-234m	Th-234 (then Pa-234m then Ra-226)	
U-234	Th-234 (then Pa-234m then Ra-226)	
Th-230	Th-234 (then Pa-234m then Ra-226)	
Ra-226	Th-234 (then Pa-234m then Ra-226)	
U-235	Assigned the highest concentration from previous site data.	

Table 1. The table shows various parents assigned to progeny concentrations depending if equilibrium has been established.

Ideally, EPA would prefer to use the On-site HpGe for quantifying all site soil samples with the assumptions outlined in Table 1. The idea behind Table 1 is for radionuclides with low abundance or competing peaks, if the activity is much greater than background, all peaks should easily be identified and quantified. However, since the On-Site HpGe is new to the Site and not enough samples have been analyzed to test Table 1 assumptions, EPA will use the On-Site lab for all samples but send selective samples to the fixed laboratory when determining accurate concentrations used to quantify the waste and down blending purposes.

In the future, the results from the certified fixed laboratory will be compared to the on-site HpGe to determine if the above assumptions are comparable. If the on-site lab results, with the assumptions made in Table 1, are accurate, the on-site HpGe may be used for quantifying waste and down blending calculations. For example, Th-228 can be used as a proxy for Th-232. This will only occur if approval from US Ecology's Health Physicist is granted. For beginning operations until approved otherwise, soil samples used for waste characterization must be quantified by a certified fixed laboratory.

### Segregating Waste

Although each Area is unique, in general, the same approach will be used to ensure that the WAC and transportation regulations have been met. Each Area will be assessed independently to determine the concentrations within each specific pile(s) or layer(s) of slag/contamination within each Area. In addition, each Area will be given two concentration value names: “low” concentration where the levels are roughly below 100mg/kg and “high” concentration where concentrations are roughly greater than 200 mg/kg. The determination of the threshold for low vs. high will be assigned to each Area specifically. In certain situations, a “medium” concentration may be needed (e.g. portions of a specific Area that falls between low and high concentration values). The low concentration locations within each Area will be used to blend the high concentrations within that specific Area. In some instances, the high and/or low from another Area maybe used to blend other Areas, if needed. Figure 3 shows an example of how blending would occur from two different Areas.

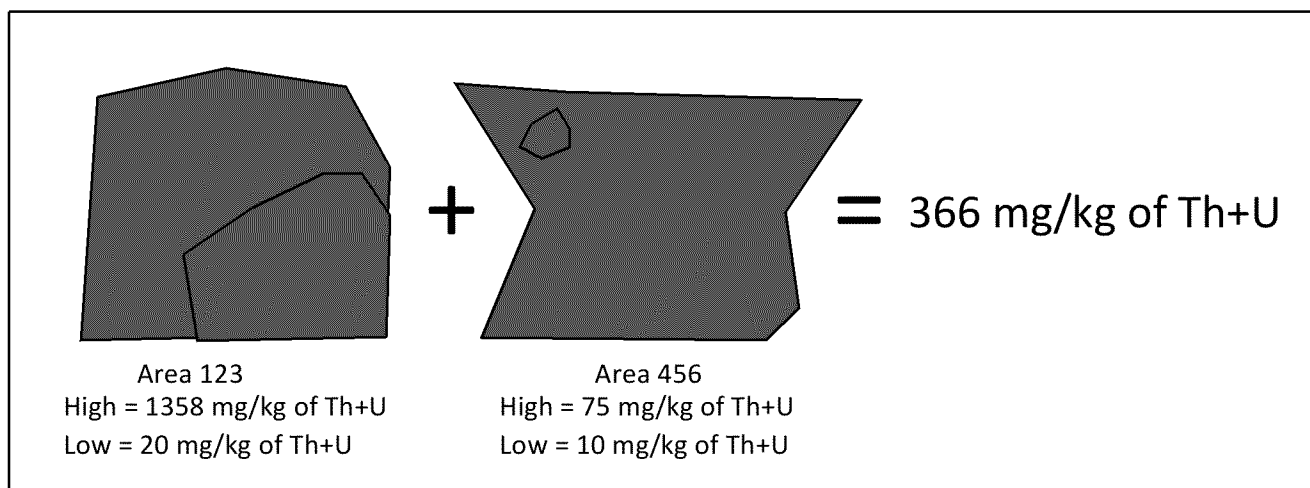


FIGURE 3: The high concentration pile within Area 123 could be blended by adding the low concentration pile from Area 456 to obtain a total concentration of less than 500 mg/kg of Thorium and Uranium, as well as, Ra-226 less than 50pCi/g.

Based on both scanning data and sampling results, the high level concentration material and the low level concentration material will be segregated by either cubic yard boxes, super sacks, and/or piles within each area if concentrations require blending (*i.e.* area concentrations of total thorium and uranium are above 500 mg/kg and/or Ra-226 above 50pCi/g). To be conservative, EPA will over-estimate the location of “high” contamination both by surface area, as well as, depth (e.g. going down to native clay) while using the highest concentration. EPA is not accounting for this natural blending during this segregation phase if some low level material gets mixed into the high level material while conducting excavation operations. This is another conservative way to estimating concentrations. In addition, for asphalt and/or concrete that is adhered to slag, the concentration for asphalt will not be incorporated into the high level concentration. Once the high concentration material has been removed from the low concentration material, a scan will determine if all high concentration material has been completely segregated. A relationship between scan data will be correlated with soil sampling data to determine at what level will constitute high concentration material from low concentration material.

Removal of the high concentration material may be performed multiple times to ensure all high concentration material has been removed.

#### Calculations for Disposal

For every area, waste management practices must be in place to ensure concentrations do not exceed the WAC and that concentrations, if blended, remain the same—nothing added or taken away from the blended piles. To do this, multiple calculations must be computed. First, a calculation of the mg/kg of total Uranium and Thorium and pCi/g of Ra-226 of each Area as it currently stands must be performed. This will answer one the following questions:

- Is blending necessary for disposal?
- Could this area be used for blending of other areas?
- Or is this area right at the WAC where it should be disposed as is?

This calculation will also compute at what depth of low concentration soil would be needed to meet the WAC. For example, the calculation may show that only one foot of low concentration soil depth is needed to meet the WAC. Instead of going down to two feet, the remaining foot of low concentration material could be utilized in other areas to meet the WAC.

If the area exceeds the WAC, blending must be considered. To calculate blending within an area, the following equation is used:

$$\left( \frac{\text{mg/kg of Ra-226}}{\text{Volume}} \right) \times \left( \frac{\text{Volume}}{\text{Volume}} \right) = \left( \frac{\text{mg/kg of Ra-226}}{\text{Volume}} \right) \times \left( \frac{\text{Volume}}{\text{Volume}} \right)$$

or for multiple blending:

$$\frac{\text{mg/kg of Ra-226}}{\text{Volume}} + \left( \frac{\text{mg/kg of Ra-226}}{\text{Volume}} \right) \times \left( \frac{\text{Volume}}{\text{Volume}} \right) = \left( \frac{\text{mg/kg of Ra-226}}{\text{Volume}} \right) \times \left( \frac{\text{Volume}}{\text{Volume}} \right)$$

Where Volume<sub>WAC</sub> is the sum of Volume<sub>High</sub> + Volume<sub>Low</sub>

A spreadsheet with calculations will be performed for each Area showing:

- Th+U Concentrations of the Area prior to blending
- Ra-226 pCi/g of the Area prior to blending
- Calculations of blending from within the Area or other Areas, if blending is needed

US Ecology's Health Physicist will review over EPA's calculations and assumptions made to approve each different blending ratio of waste to ensure the WAC has been met. Any and all discrepancies must be addressed with EPA's Health Physicist(s) and US Ecology's Health Physicist prior to shipment of specific Areas/shippments.



### Logistics for Disposal

The blending calculation is based off of a set volume. This could be either the number of cubic yard boxes, super sacks, and/or the volume of scoops from piles to directly live-load into the trucks leaving for US Ecology. To ensure that the mg/kg calculated does not change, a system has been established to ensure that concentrations are maintained and weights of each load is met. Attachment D shows a layout of how blending will occur, transported, staged, and properly disposed once disposal trucks arrive at the site.

Step 1: After high level material has been separated from low level material and concentrations for both have been determined, a calculation will be performed to determine a specific ratio for specific high level material piles/cubic yard boxes/super sacks to specific low level material piles/cubic yard boxes/super sacks. The ratio must be maintained.

Step 2: Depending on the ratio of the number of high level material to low level material, the specific number of piles/cubic yard boxes/super sacks will be placed in a designated Bay #. The tare weight of the skid steer will be documented. Then the skid steer containing piles/cubic yard boxes/super sack of material will be weighed before the piles/cubic yard boxes/super sacks are placed in the designated Bay #.

Step 3: Once all of the material is placed in the Bay and the weight of the total Bay is ensured that it is less than the required transportation weight, the material in the Bay can be transferred to the US Ecology dump trailer by the large excavator.

PRECAUTION: As a precaution, low level material will be placed in the dump trailer first in case EPA's calculated load weight does not coincide with the US Ecology dump trailer driver's weight determination. The dump trailer load will never go over the WAC by placing low level material first and less high level material than originally calculated. If additional material is needed to fill the dump trailer capacity beyond the amount designated in the specific Bay, then calculations will be performed to determine the ratio needed to keep concentrations below 500 mg/kg. Once material is in its designated Bay, no material from one Bay may be added to another since there is not a homogenous mix of material.

### Post Transport

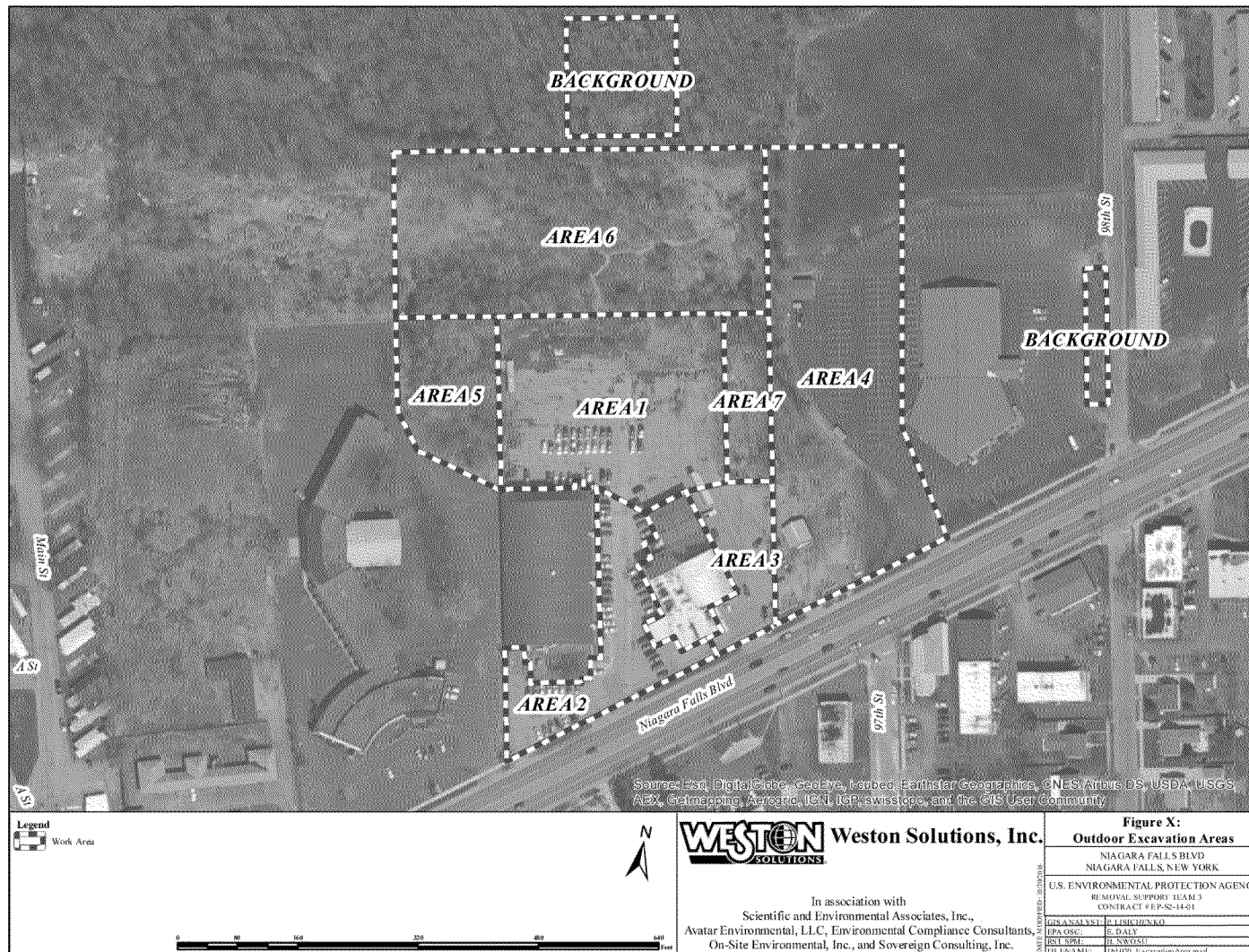
After a specific dump trailer transports the material off the Site, EPA will document the exact quantities if any addition/subtraction of material took place from the material designated in the Bay(s).

Once a Bay becomes open, a new calculation will be performed to determine the next Bay ratios from the next specific areas.

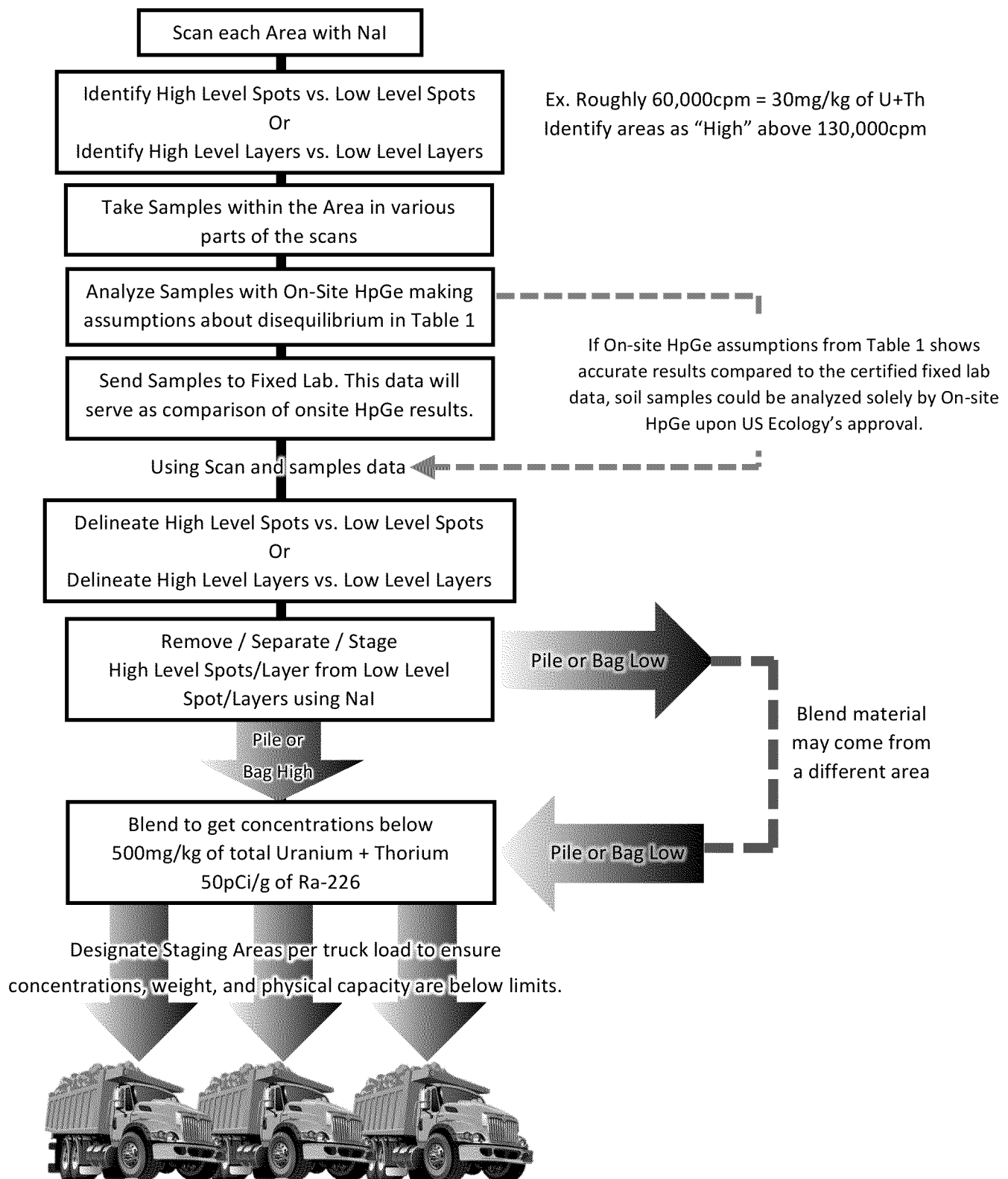
## Attachment A: Site Map



## Attachment B: Site Map Divided into Distinct Areas



## Attachment C: EPA's Approach for Disposal





# Attachment D: Example of Logistics for Disposal

